http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (2): 309-312, 2000

Efficacy of Different Sex Pheromone Traps for Monitoring and Control of Pink Bollworm *{Pectinophora gossypiella* (Saunders) *Gelechlidae: Lepidoptera}*

M. R. Attique, M. M. Ahmad[1] and Z. Ahmad
Central Cotton Research Institute, Multan, Pakistan
[1]Department of Biological Sciences, Quaid-I-Azam University, Islamabad, Pakistan

Abstract: Five trap designs yellow and white funnel, Delta red and white and universal were evaluated for their catching efficiency. Yellow funnel was most efficient for catching male moths followed by white funnel and then Deltas red and white. Universal trap was most inefficient. In the field where no plant protection was given against bollworms and mass trapping was done, pink bollworm infestation in the bolls was much less as compared with untreated check (control). In area where insecticides were compared with mass trapping, reduction in pesticide use was 33 percent. Infestation in the bolls was much less than where farmer used insecticides. Pink bollworm control with PB Rope, small and large tea bags by using mating disruption technique was better than that of plots where farmer used insecticides. Maximum pink bollworm attack was 22 percent in the insecticide treated area as compared with 6% in the pheromone treated block.

Key words: Pink bollworm, pheromone, trap designs, monitoring mass trapping, communication disruption

Introduction

Cotton crop is liable to pest attack from seedling to harvesting. Losses caused by these pests mainly of bollworms, varied from 30-40 percent (Ahmad, 1980). Among the bollworms *Pectinophora gossypiella* (Saunders) is one of the most important pest of cotton, not only in Pakistan but also in other cotton growing countries of Asia, Australia, America and Africa (Ingram, 1994). Its infestation in Western Punjab including Multan and D.G. Khan areas was low in late twenties (Bindra, 1928). With the increase in the availability of irrigation water and use of fertilizer it has become serious in these areas. Critical insect control methods revealed that chemical control of this pest is difficult as the larvae remain protected in the bolls for most of the time. The pheromone of this species has been isolated and identified by Hummel *et al*. (1973) and Bierl *et al*. (1974) and were used for monitoring and control of this pest by using mass trapping and mating disruption techniques in different parts of the world. There is a need to develop its integrated pest management. To develop this, evaluation of different trap designs for monitoring with pheromone by using mass trapping and communication disruption were under taken and the results are reported here.

Materials and Methods

Trap designs: Four types of traps viz. Delta red, Delta white, Funnel white and locally manufactured universal traps were placed randomly in a single row at the Punjab Seed Corporation Farm, Khanewal during 1991 in three replications. Positions of traps were not changed during 25 days study period. Nomate PBW fibre dispenser was used in all the traps. A second trial was conducted with an additional yellow funnel trap with five replications. All these traps were installed in a single row in harvested cotton fields. The trap positions were changed every fifth day so that each trap had an equal chance for attracting moths. In both the trials moth catches were recorded daily and average population/trap/five days was presented.

Mass trapping: First trial was conducted on September 13, 1992 at Khokhran on a 2.4 hectare block of cotton variety S-12. A total of thirty pheromone baited traps in three replications were installed. These traps were replaced after 2-3 weeks. Another adjoining 2.4 ha plot was kept as control. The distance between the traps was 25 m. No plant protection measures were taken during the season in control and where mass trapping was done. Infestation was determined by sampling 400 bolls (14-21 d old) per block at weekly intervals. Number of pink bollworm moths in the trapped area were also recorded.

Second trial was conducted 65 km North East of Multan at the Punjab Seed Corporation, Khanewal during 1992 crop season. At squaring stage 144 traps were placed on 12 ha. block of cotton variety CIM-240 in three replicates. The distance between each trap was 25 m. The traps were replaced after 2 to 3 weeks. A 12 ha. block on a distance of 200 meters from the test plot was kept as control. In the block where pheromone traps were installed one application of disyston, 12 kg ha^{-1} against sucking pests and one application each of endosulfan and guzathion was given against *Earias* species. In the block that was kept as control one granular and five foliar applications of endosulfan, guzathion carbryl, endosulfan and guzathion were given. The pink bollworm infestation was determined by sampling 400 bolls (14 to 21 d-old) from each block at weekly intervals.

Mating disruption: The pink bollworm control through mating disruption with 20 cm PB-Rope a sex pheromone was investigated about 40 km North East of Multan at farmers' field. Application of PB-Rope, was given only once at the pin square stage on 11 ha. cotton block of variety CIM-240 during 1993. The ropes were tied 10 to 12 cm on the top of the plant at the rate of 500 pieces/ha, The distance between the pieces was 4.5 m. A similar block of cotton was kept as untreated check (control) where insecticides were used to control the bollworms. To assess the mating disruption of pink bollworm two pheromone impregnated traps were placed each in the pheromone treated area and control. Pink bollworm infestation was determined by dissecting 100 bolls each from pheromone treated and control area at weekly intervals.

Efficacy of low cost gossyplure impregnated (Shin-Estu, Japan) in two sizes of plastic bags described as small and large Tea Bags was compared with 20 cm PB-Rope on 12 ha block of cotton variety CIM-240 during 1994 at farmer's field. The crop was sown on 29th June. Pheromone application was made once on 30th of July at the pin square stage. A total of 500 pieces of PB-Ropes, 500 small tea bags and 250 of large tea bags per ha. were tied manually 16-20 cm above the ground with the main stem. Distance within and between the rows was 4.5 m for PB-Rope and small tea bags and 6.5 m for large tea bags. One block of 2.4 ha was kept without tea bags where farmer used his own pesticide regime. In the center of pheromone treated plot, 0.2 ha plot was kept as untreated check where one foliar application of insecticide was made for the control of sucking pests and no insecticide was used to control *Earias* spp. To assess the communication disruption in the pink bollworm, three

pheromone-baited traps were placed each in pheromone and insecticide treated area. The pink bollworm infestation was determined by dissecting 100 bolls from each treatment at weekly intervals.

Results

Trap designs: Moths were recorded daily for 25 days. The average number of moths trapped for five days is given in Table 1. Highest number of moths were caught in Delta white followed by Delta red, Universal and Funnel white in the experiment where positions of the traps were not changed. Catches were significantly higher in yellow funnel followed by Delta red when placed on the corners as compared with when placed between the other traps. Maximum moths were caught in Delta white followed by Delta red, yellow funnel and white funnel when they were placed between the traps and positions of the traps were changed. Overall Universal trap proved inefficient when placed at the corners or in between the other traps. Delta and funnel traps proved better but yellow funnel was superior to all other types of traps.

Table 1: Number of male moths of *Pectinophora gossypiella* trapped in 5 days/trap in different type of traps at Multan

Trap design	Trap position unchanged	Trap placed on the corners	Trap placed in between the other trap
White funnel	11.1	22.5	12.1
Yellow funnel	-	114.0	26.2
Universal	12.5	4.0	6.3
Delta white	20.9	26.0	30.6
Delta red	16.9	53.0	28.1

Mass trapping: Boll infestation where mass trapping was done and untreated field at Khokhran is presented in Table 2. Moth catches were low in September with a peak in October in the block where traps were placed. Pink bollworm infestations in both the areas were almost equal when trial was started. Infestations was reduced one week after the traps were installed as compared with untreated check and remained at the same level till the end of season. However, infestation in the mass trapping area was also above the threshold because of high pest pressure. In the control infestation gradually increased and was 26 percent at the end of October when moth catches were also highest (Table 2).

Rate of infestation of pink bollworm in mass trapped area and control and the number of moths caught in trapped area at Khanewal are presented in Table 3. In August pink bollworm males population trapped in the pheromone treated area was low. Maximum moths were caught at the end of September and October when pest was most active with a peak in the second fortnight of September. Infestation in pheromone and insecticide treated areas was zero when trial was started. In the middle of August infestation started and was below economic injury level in both the treatments. However, it was much lower in mass trapped block as compared with insecticide treated area. During September and October infestation remained above the threshold level where farmer used his own pesticide regime. Fifty percent reduction in insecticide use was achieved in mass trapping area. It indicated that mass trapping reduced the pink bollworm infestation considerably but the growers have to use insecticides for other bollworms.

Communication disruption: Number of *Pectinophora gossypiella* male moths caught/trap/week and infestation in susceptible bolls in the pheromone and insecticide treated area are given in Fig. 1 and 2.

In the pheromone treated area, moth catches remained zero throughout the season resulting 100 percent mating disruption. Male moths were active throughout the season in the insecticide treated area. Number was low in August. Gradually catches increased with a peak of 1004 moths/trap/week in the middle of September (Fig. 1). In the pheromone treated area two insecticidal applications of dimethoate against *Amrasca devastans* (Dist.) in whole block and two of Polytrin-C, (mixture of profenofos + cypermethrin) against *Earias* species, each on 1.6 hectares were given. In this block low level of infestation was found possibly gravid females entered from the nearby fields. In the plot where farmer used insecticide, two applications of insecticide were given against *A. devastans* and three for bollworms. In spite of five applications of insecticide, pink bollworm infestation in the block where farmer used insecticides went up to 22 percent as compared with 6 percent in the pheromone treated block (Fig. 2). In addition to better quality, higher yield of seed cotton was obtained. The yield of seed cotton was 2408 kg ha^{-1} in the pheromone treated block as compared with 2156 kg ha^{-1} in the insecticide treated area.

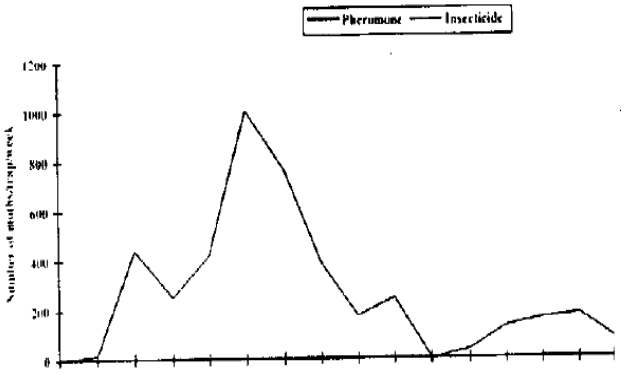

Fig. 1: Number of *Pectinophora gossypiella* male moths caught/trap/week in the pheromone and insecticide treated plots during 1993

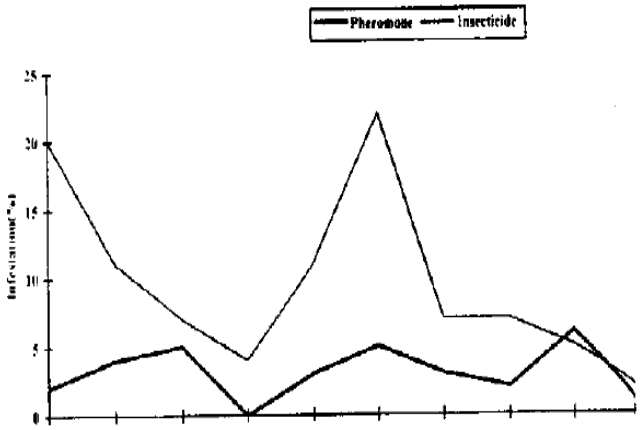

Fig. 2: Infestation of *Pectinophora gossypiella* in the PBW Rope and insecticide treated plots during1993

Table 2: Rate of infestation of *Pectinophora gossypiella* in control and where traps were placed and number of moths trapped at Khokhran

Observation period		Boll infestation (%)		No. of males trapped
Months	Weeks	Mass trapped	Control	
September*	II	7.3	8.0	
September	III	6.0	15.0	120
September	IV	5.7	16.0	390
October*	I	6.0	16.0	413
October	II	5.3	20.0	1015
October	III	7.3	21.0	1036
October	IV	8.3	26.0	1088

*Dates when pheromone and new traps were placed or replaced

Table 3: Rate of infestation of *Pectniphora gossypiella* where mass trapping was done and control and number of males caught in mass trapped area at Khanewal

Observation period		Boll infestation (%)		No. of males trapped
Months	Weeks	Pheromone**	No pheromone***	
August*	I	0.0	0.0	0
August	II	0.4	1.9	2476
August	IV	2.3	6.4	2317
September*	II	3.5	12.9	1886
September	IV	2.7	15.3	10684
October	II	5.6	7.5	2735
October	IV	6.0	9.3	10195

*Dates when new traps were placed or replaced, **Sex pheromone treated = 1 granular + 2 foliar applications, ***Insecticide treated (control) = 1 granular + 5 foliar applications

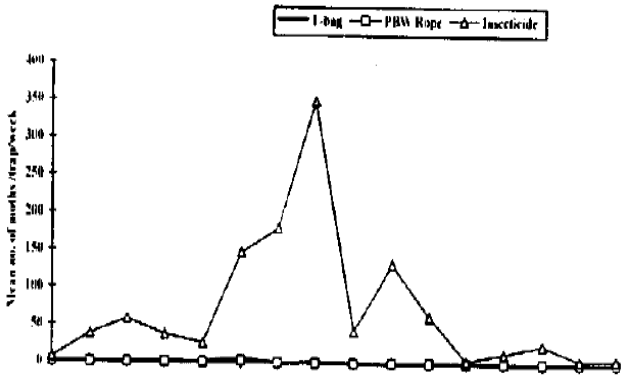

Fig. 3: Mean number of male moths of *Pectinophora gossypiella* caught in plots with tea bag, (average of small and large) PBW Rope and insecticides during 1994

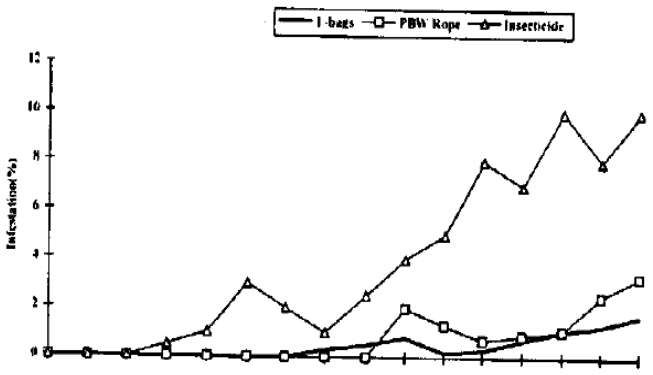

Fig. 4: Infestation of *Pectinophora gossypiella* in the plots treated with tea bag, (average of small and large) PBW Rope and insecticides during 1994

Male moths catches and infestation of pink bollworm in the pheromone and insecticide treated areas are presented in Fig. 3-4. Male moth catches were low during early August in the pheromone and insecticide treated areas. Population gradually increased with a peak at the end of September when maximum catches were 360/trap/week. Mating suppression was 99 percent in the pheromone treated plot (Fig. 3). Infestation in flowers and bolls was also very low as compared with insecticide regime (Fig. 4). Sucking pests were controlled with dimethoate two times in both the blocks. In pheromone treated area *Earias* spp. were controlled with profenofos + cypermethrin two times at recommended dose rate. In insecticide treated plot, *Earias* species were controlled with dimethoate + cypermethrin, profenofos + cypermethrin and bifenthrin. Thus reduction in pesticide use against bollworms was almost 33 percent.

Moth suppression was also 99 percent in the centre of pheromone treated plot where only one foliar application of insecticide was given against sucking pests and no insecticide was used against *Earias* species.

Small and large tea bags returned from the field to Japan were also analysed. Hundred days after placement left over of the originally loaded pheromone was 21 percent in the small tea bag and 27 percent in the large tea bags (ShinEstu Chemical PVT Limited (Personal communication). The yield of seed cotton was 1866 kg ha^{-1} in large, 1737 kg ha^{-1} in small tea bags and 2080 kg ha^{-1} in PB-Rope as compared with 1507 kg ha^{-1} where insecticides were used. In the centre of the pheromone treated area where only sucking pests were controlled and no application of

insecticide against bollworms was made, the yield of seed cotton was 1388 kg ha^{-1}.

Discussion

Among the tested designs yellow or white funnel were superior than the imported Delta red and white indicating that design of the pheromone trap can affect their catching efficiency. Because of better catches funnel traps are recommended for use.

The results revealed that mass trapping reduced the pink bollworm infestation considerably. In the presence of large number of moths there are chances to escape, therefore infestation is likely to develop at low level in the mass trapping area. Over all control was better on large area as compared with small, To mitigate against the entry of gravid female moths, treatment of large blocks are essential but for this purpose cooperation between large number of small farmers within given area would be necessary. Overall mass trapping is laborious, as checking of traps, replacement of traps and pheromone is required regularly, therefore difficult to undertake on large area unless the labour is fully trained. In the U.S.A. Flint *et al*. (1976) reported mass trapping as an effective control measure, Huber *et al*. (1979) mentioned that infestation was 1.9 percent where massing trapping was done as compared with 4.2 percent in the immediate three preceding years when mass trapping was not done.

Communication disruption was more effective than mass trapping and the single early season application of Shin-Estu PB Rope or tea bags resulted reduction in infestation at all stages of crop growth. However it is not possible to bring infestation to zero level at high pest pressure, as the mated females are likely to enter in the pheromone treated area. The results are similar to those of Shorey *et al*. (1974) and Staten *et al*. (1987) in the U.S.A. and in Egypt reported by Critchley *et al*. (1983, 1985), Campion *et al*. (1989), El-Adl *et al*. (1988), McVeigh *et al*. (1983) and Moawad *et al*. (1991) and in Pakistan by Attique (1985), Qureshi and Ahmed (1989) and Chamberlain *et al*. (1993).

At present farmers have not adopted because it is species specific and they have to spray for *Earias* species and *Helicoverpa* even if pheromone have been used. Reduction in pesticide use was 33 percent in addition to good quality cotton and higher yield of seed cotton was also achieved.

It is high time that a sound combination of pest control agents must be assembled to provide adequate control with minimum environmental hazards. The implementation of Integrated Pest Management (IPM) by using, pheromone and insecticide when needed as major components will not only reduce the cost of cotton production, it will also increase yield without polluting the environment.

Control of pink bollworm by insecticides is difficult unless the timing of applications is achieved with great precision. Since for the most part of larvae are generally well protected within the developing bolls and the pink bollworm pheromone is aimed at the adults stage, which is always exposed within the crop, correct timing of pheromone formulation becomes less important and prophylactic spraying is acceptable in the absence of mammalian toxicity, no adverse effects on environment will occur and the beneficial insects will be preserved.

References

Ahmad, Z., 1980. Incidence of major cotton pest and disease in pakistan with special reference to pest management. Proceeding of the International Consultation on Cotton Production Research with Focus on Asian Region, November 17-21, 1980, Manila, Philippine, pp: 1-11.

Attique, M.R., 1985. Pheromones for the control of cotton pests in Pakistan. Pak. Cottons, 29: 133-136.

Bierl, B.A., M. Beroza, R.T. Staten, P.E. Sonnet and V.E. Adler, 1974. The pink bollworm sex attractant. J. Econ. Entomol., 67: 211-216.

Bindra, S.S., 1928. Studies of *Platyedra gossypiella* Saunders, (Pink bollworm) in the Punjab, Part I. Mem. Dept. Agric. (Indian Entomol. Serv.), 10: 167-216.

Campion, D.G., B.R. Critichley and L.J. McVeigh, 1989. Mating Disruption. In: Insect Pheromones in Plant Protection, Jutsum, A.R. and F.R.S. Gordon (Eds.). John Wiley and Sons Ltd., Chichester, UK., pp: 89-119.

Chamberlain, D.J., Z. Ahmad, M.R. Attique and M.A. Chaudhry, 1993. The influence of slow release PVC resin pheromone formulations on the mating behaviour and control of the cotton bollworm complex (Lepidoptera: Gelechiidae and Noctuidae) in Pakistan. Bull. Entomol. Res., 83: 335-343.

Critchley, B.R., D.G. Campion, I.J. McVeigh, P. Hunter-Jones and D.R. Hall *et al*., 1983. Control of pink boll worm, *Pectinophora gossypiella* (Saunders) (Lepidop-tera: Gelechiidae), in Egypt by mating disruption using an aerially applied microencapsulated pheromone formulation. Bull. Entomol. Res., 73: 289-299.

Critchley, B.R., D.G. Campion, L.J. McVeigh, E.M. McVeigh and G.G. Cavanagh *et al*., 1985. Control of pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae), in Egypt by mating disruption using hollow-fibre, laminate-flake and microencapsulated formulations of synthetic pheromone. Bull. Entomol. Res., 75: 329-346.

El-Adl, M.A., M. Hosny and D.G. Campion, 1988. Mating disruption for the control of pink bollworm *Pectinophora gossypiella* (Saunders) in the delta cotton growing area of Egypt. Int. J. Pest Manage., 34: 210-214.

Flint, H.M., R.I. Smith, L.A. Bariola, B.R. Horn, D.E. Forey and S.J. Kuhn, 1976. Pink bollworm: Trap tests with gossyplure. J. Econ. Entomol., 67: 238-240.

Huber, R.T., L. Moore and M.P. Hoffmann, 1979. Feasibility study of area-wide pheromone trapping of male pink bollworm moths in a cotton insect pest management program. J. Econ. Entomol., 72: 222-227.

Hummel, H.E., L.K. Gaston, H.H. Shorey, R.S. Word, K.J. Byrni and R.M. Silverstein, 1973. Clarification of the chemical status of the pink bollworm sex pheromone. Science, 181: 873-875.

Ingram, W.R., 1994. *Pectinophora* (Lepidoptera: Gelechiidae). In: Insect Pests of Cotton, Mathews, G.A. and J.P. Tunstall (Eds.). CAB International, UK., pp: 577.

McVeigh, L.J., B.R. Critchley and D.G. Campion, 1983. Control of the pink bollworm in Egypt by mating disruption using pheromones. Proceedings of the 10th International Congress of Plant Protection, November 20-25, 1983, England, pp: 268.

Moawad, G., A.A. Khidr, M. Zaki, B.R. Critchley, L.J. McVeigh and D.G. Campion, 1991. Large-scale use of hollow fibre and microencapsulated pink bollworm pheromone formulations integrated with conventional insecticides for the control of the cotton pest complex in Egypt. Int. J. Pest Manage., 37: 10-16.

Qureshi, Z.A. and N. Ahmed, 1989. Efficacy of combined sex pheromones for the control of three major bollworms of cotton. J. Applied Entomol., 108: 386-389.

Shorey, H.H., R.S. Kaae and L.K. Gaston, 1974. Sex pheromones of Lepidoptera. Development of a method for pheromonal control of *Pectinophora gossypiella* in cotton. J. Econ. Entomol., 67: 347-350.

Staten, R.T., H.M. Flint, R.C. Weddle, E. Quintero and R.E. Zarate *et al*., 1987. Pink bollworm (Lepidoptera: Gelechiidae): Large-scale field trials with a high-rate gossyplure formulation. J. Econ. Entomol., 80: 1267-1271.